Structural soil health status revealed by soil shrinkage dynamics

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The modeling of physical soil processes in hydrological or land surface models assumes that soils are rigid with spatial arrangement of soil constituents that stays constant and does not change with wetness state or season. This is an over-simplification that can lead to poor process prediction at various scales. A key step for the foundation of better models is the consideration of soil shrinkage with decreasing water content, which is increasingly strong with increasing clay and organic matter content. As a result of decreasing water content, aggregates are rearranged, reducing the volume of large pores, and interstitial water between clay particles is removed.

The measurement of the shrinkage as function of soil water content (a relationship denoted as shrinkage curve) determines the amount of soil structures that allow fast drainage after heavy rainfall, suppressing anaerobic conditions and onset of water ponding and erosion. The characterization of the shrinkage curve is thus a quantitative tool to assess the structural integrity of a soil and its macropores.

The primary objective of this master thesis is the measurement of shrinkage curve of clayey soils collected in a field campaign in the canton of Jura (Switzerland). After sample collection and conducting shrinkage experiments, the structural parameter values are deduced from the shrinkage curve and are related to basic soil properties like clay content, amount of organic matter, and the visual assessment of the samples in the field and in the lab.

The student should have experience in lab work and be interested in sampling and data analysis. The measurement of soil shrinkage curve will be conducted at Agroscope (Reckenholz). The analysis of the data and assessment of structural properties and soil health takes place at ETH Zurich.

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